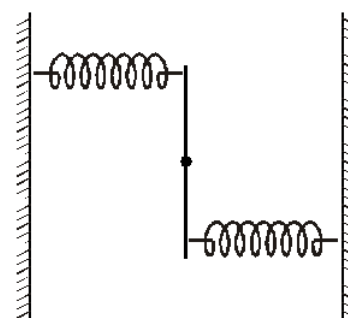


PART-I : PHYSICS

1) A uniform solid cylinder of mass 5 kg and radius 0.1 m is resting on a horizontal platform (parallel to the x-y plane) and is free to rotate about its axis along the y-axis. The platform is given a motion in the x direction given by $x = 0.2 \cos(10t)$ m. If there is no slipping, then maximum torque acting on the cylinder during its motion is :

- (1) 0.2 N-m
- (2) 2.0 N-m
- (3) 5.0 N-m
- (4) 10.0 N-m

2) A uniform rod of length L and mass M is pivoted at the centre. Its two ends are attached to two springs of equal spring constants k. The springs are fixed to rigid supports as shown in the figure, and the rod is free to oscillate in the horizontal plane. The rod is gently pushed through a small



angle θ in one direction and released. The frequency of oscillation is

- (1) $\frac{1}{2\pi} \sqrt{\frac{2k}{M}}$
- (2) $\frac{1}{2\pi} \sqrt{\frac{k}{M}}$
- (3) $\frac{1}{2\pi} \sqrt{\frac{6k}{M}}$
- (4) $\frac{1}{2\pi} \sqrt{\frac{24k}{M}}$

3)

The displacement x of a particle at a time t is given by $x = 5 \sin 2t$ where x is in meter and t is in second. A simple pendulum has the same period as the particle when the length of the pendulum is

- (1) 10.0 m
- (2) 5.0 m
- (3) 2.5 m
- (4) 2.0 m

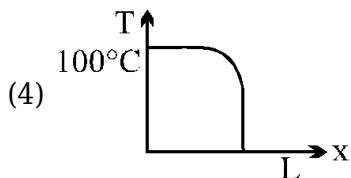
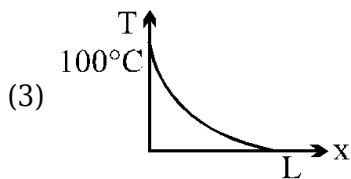
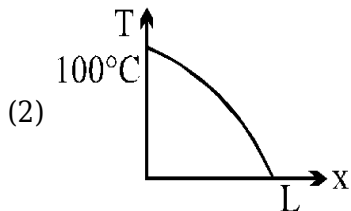
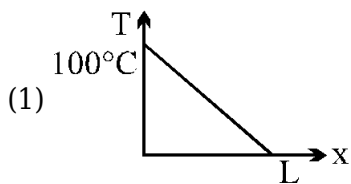
4) If on heating liquid through 80°C , the mass expelled is $(1/100)^{\text{th}}$ of mass still remaining, the coefficient of apparent expansion of liquid is

- (1) $1.25 \times 10^{-4}/^{\circ}\text{C}$
- (2) $12.5 \times 10^{-4}/^{\circ}\text{C}$
- (3) $1.25 \times 10^{-5}/^{\circ}\text{C}$
- (4) None of these

5) A thermometer with an arbitrary scale has the ice point at -20° and the steam point at 180° . When the thermometer reads 5° , a centigrade thermometer will read

- (1) 7.5°C
- (2) 12.5°C
- (3) 16.5°C
- (4) None of these

6) A rod of length L and uniform cross-sectional area has varying thermal conductivity which changes linearly from $2K$ at end A to K at the other end B . The ends A and B of the rod are maintained at constant temperature 100°C and 0°C , respectively. At steady state, the graph of temperature : $T = T(x)$ where x = distance from end A will be



7) Solar radiation is found to have an intensity maximum near the wavelength range of 470 nm . Assuming the surface of sun to be perfectly absorbing ($a = 1$), calculate the temperature of solar surface.

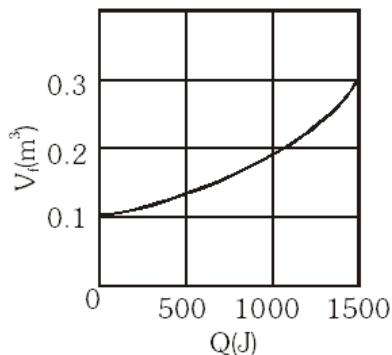
- (1) 6125 K
- (2) 6225 K

(3) 6335 K

(4) 6445 K

8) Suppose 0.5 mole of an ideal gas undergoes an isothermal expansion as energy is added to it as heat Q . Graph shows the final volume

V_f versus Q . The temperature of the gas is (use $\ln 9 = 2$ and $R = \text{J/mol-K}$)



(1) 293 K

(2) 360 K

(3) 386 K

(4) 412 K

9) A quantity of heat Q is supplied to a monoatomic ideal gas which expands at constant pressure. The fraction of heat that goes into work done by the gas is :

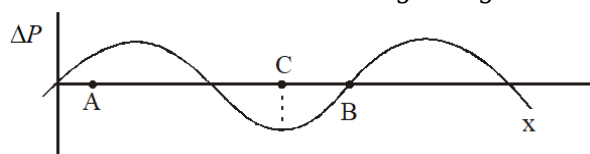
(1) $2/5$

(2) $3/5$

(3) $2/3$

(4) 1

10) Sound wave in form of sine wave is travelling along $+x$ axis $\Delta P - x$, graph is shown. Choose



incorrect options.

(1) Particle on just left side of A and just right side of A are moving in opposite directions

(2) Speed of particle on just left of A is less than that on right of A

(3) Particles on just left and just right of B have opposite direction of motion

(4) Particles on just left and just right of C are moving in same direction

11) Consider a wave represented by $y = a \cos^2(\omega t - kx)$ where symbols have their usual meaning.

This wave has (here $k = \frac{2\pi}{\lambda}$) :

(1) An amplitude a , frequency ω and wave length λ

(2) An amplitude a , frequency 2ω and wave length 2λ

- (3) An amplitude $\frac{a}{2}$, frequency 2ω and wave length
- (4) An amplitude $\frac{a}{2}$, frequency 2ω and wave length λ

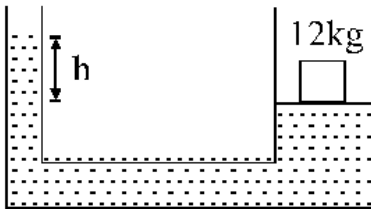
12) Energy of electron in first orbit of He^+ is y joule. Then the potential energy of electron in second orbit of He^+

- (1) $\frac{y}{4}$ J
- (2) $\frac{y}{2}$ J
- (3) $\frac{-y}{2}$ J
- (4) $\frac{-y}{9}$ J

13) The de-Broglie wavelength of an electron in the first Bohr orbit is

- (1) Equal to the circumference of first orbit
- (2) Equal to $\frac{1}{2} \times$ (circumference of first orbit)
- (3) Equal to $\frac{1}{4} \times$ (circumference of first orbit)
- (4) Equal to $\frac{3}{4} \times$ (circumference of first orbit)

14) The area of cross-section of the wider tube shown in figure is 800 cm^2 . If a mass of 12 kg is placed on the massless piston, the difference in heights h in the level of water in the two tubes is :



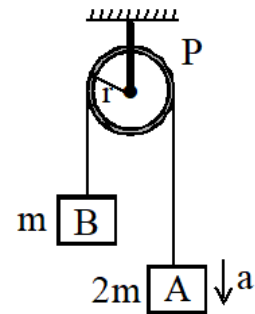
- (1) 10 cm
- (2) 6 cm
- (3) 15 cm
- (4) 2 cm

15) What would the length of the earth's day be if a pendulum suspended at some point along the equator does not swing (i.e., when it is pulled away from its equilibrium point, it does not swing down again)?

- (1) 24 hr
- (2) 1.2 hr
- (3) 1.4 hr

(4) 2.4 hr

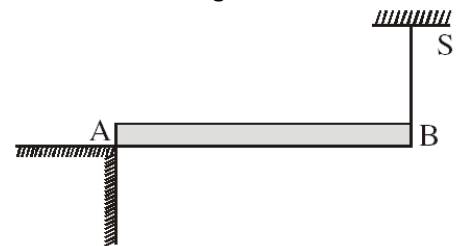
16) In the figure the block 'A' has acceleration 'a' downward. The pulley 'P' has a radius r and some



mass. The string does not slip on the pulley. Then which one is incorrect ?

- (1) The two sections of the string have unequal tensions
- (2) The two blocks have acceleration of equal magnitude
- (3) The two blocks have acceleration of equal magnitude $\frac{a}{r}$
- (4) $a > \frac{g}{3}$

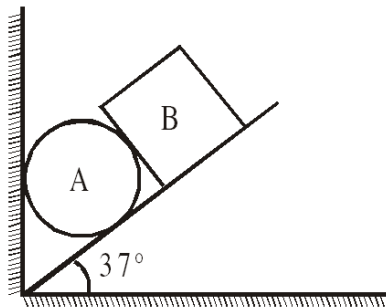
17) A linear rod of mass m , length ℓ is placed as shown in figure such that its one end rests on a rough table of friction coefficient μ . When string BS is cut, rod AB starts falling from rest. At an



angle $\theta = \tan^{-1} \left(\frac{\mu}{2x} \right)$, rod starts slipping on the table, find x ?

- (1) 5
- (2) 2
- (3) 4
- (4) 1

18) A perfect smooth sphere A of mass 2 kg is in contact with a rectangular block B of mass 4 kg and vertical wall as shown in the figure. All surfaces are smooth. Find normal reaction by vertical



wall on sphere A

- (1) 20 N
- (2) 25 N

(3) 80 N

(4) 45 N

19) In a series L-C-R circuit, $C = 10^{-11}$ Farad, $L = 10^{-5}$ Henry and $R = 100$ Ohm, when a constant D.C voltage E is applied to the circuit, the capacitor acquired a charge 10^{-9} C. The D.C. source is replaced by a sinusoidal voltage source in which the peak voltage E_0 is equal to the constant D.C. voltage E . At resonance the peak value of the charge acquired by the capacitor will be :

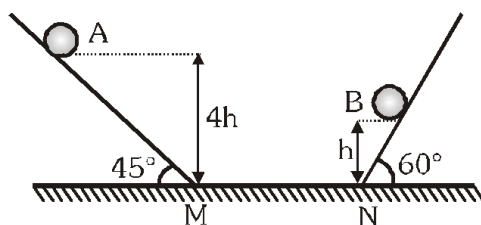
(1) 10^{-15} C

(2) 10^{-6} C

(3) 10^{-10} C

(4) 10^{-8} C

20) Two identical balls are released from positions as shown. They collide elastically on horizontal surface. Ratio of heights attained by A & B after collision is (All surfaces are smooth, neglect energy



loss at M & N)

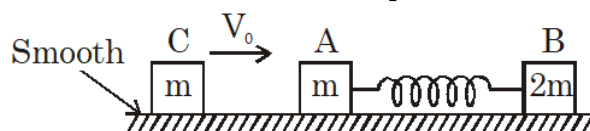
(1) 1 : 4

(2) 2 : 1

(3) 4 : 13

(4) 2 : The figure 5

21) When mass C collides with velocity V_0 along AB and collides elastically with A. After collision at the instant of maximum compression of x_0 , the common velocity and spring constant will be :



(1) $\frac{V_0}{3}, \frac{mV_0^2}{6x_0^2}$

(2) $\frac{V_0}{4}, \frac{2mV_0^2}{3x_0^2}$

(3) $\frac{V_0}{3}, \frac{2mV_0^2}{3x_0^2}$

(4) $\frac{V_0}{3}, \frac{mV_0^2}{3x_0^2}$

22) Two blocks A (1 kg) and B (3 kg) rest over the other on a smooth horizontal plane (A over B). The coefficient of static and dynamic friction between A and B is the same and equal to 0.75. The maximum horizontal force in newton that can be applied to A in order that both A and B do not have

relative motion is : $[g = 9.8 \text{ m/s}^2]$

- (1) 19.6
- (2) 14.7
- (3) 9.8
- (4) 4.9

23) The position of a particle at time t , is given by the reaction, $x(t) = \frac{v_0}{\alpha} (1 - e^{-\alpha t})$, where v_0 is a constant and $\alpha > 0$. The dimensions of v_0 & α are respectively.

- (1) $M^0 L^1 T^0$ & T^{-1}
- (2) $M^0 L^1 T^{-1}$ & T
- (3) $M^0 L^1 T^{-1}$ & T^{-1}
- (4) $M^1 L^1 T^{-1}$ & LT^{-2}

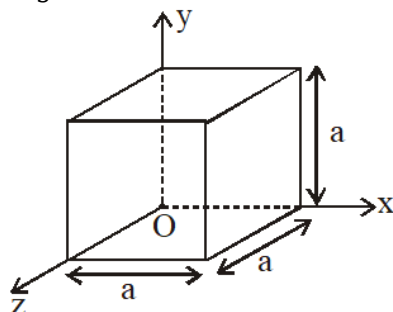
24) A vernier callipers having 1 main scale division = 0.1 cm is designed to have a least count of 0.02 cm. If n be the number of divisions on vernier scale and m be the length of vernier scale, then

- (1) $n = 10$, $m = 0.5 \text{ cm}$
- (2) $n = 9$, $m = 0.4 \text{ cm}$
- (3) $n = 10$, $m = 0.8 \text{ cm}$
- (4) $n = 10$, $m = 0.2 \text{ cm}$

25) A spherical conducting ball is suspended by a grounded conducting thread. A positive point charge is moved near the ball. The ball will

- (1) be attracted to the point charge and swing toward it.
- (2) be repelled from the point charge and swing away from it.
- (3) not be affected by the point charge.
- (4) A or B depending on the magnitude of the charge.

26) Electric field in a region is found to be $\vec{E} = 3y\hat{j}$. The total energy stored in electric field inside the

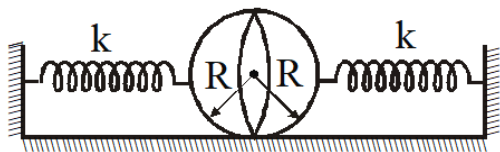


cube shown will be

- (1) $9a^5 \epsilon_0$
- (2) $3\epsilon_0 a^5$
- (3) $\frac{3}{2}\epsilon_0 a^5$

(4) 0

27) Two non-conducting hemispherical surfaces, which are having uniform charge density σ are placed on smooth horizontal surface as shown in figure. Assuming springs are ideal, calculate compression in each spring if both the hemispherical surface are just touching each other.



(1) $\frac{\sigma^2 R^2}{2\epsilon_0 k}$

(2) R

(3) $\frac{\sigma^2 \pi R^2}{2\epsilon_0 k}$

(4) None of these

28) A boat which have a speed of 5 km/hr in still water crosses a river along the shortest possible path in 15 minutes. Then width of river is (in km). If velocity of flow of river is 3 km/hr :

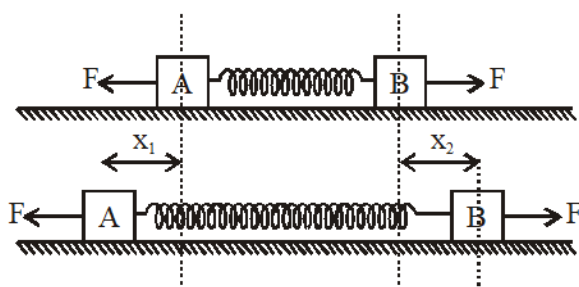
(1) 1 km

(2) $\frac{3}{4}$ km

(3) $\frac{1}{4}$ km

(4) $\frac{1}{3}$ km

29) Initially spring is relaxed having spring constant 50 N/m. If blocks A and B are displaced by x_1 and x_2 such that $x_1 = 30$ cm & $x_2 = 10$ cm. If force applied by spring on A is F_1 & on B is F_2 then :



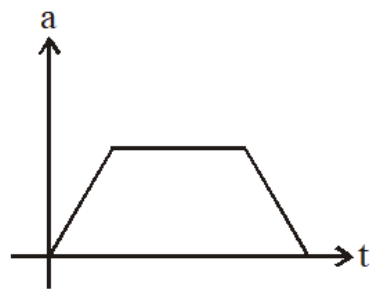
(1) $F_1 = 15$ N, $F_2 = 5$ N

(2) $F_1 = 5$ N, $F_2 = 15$ N

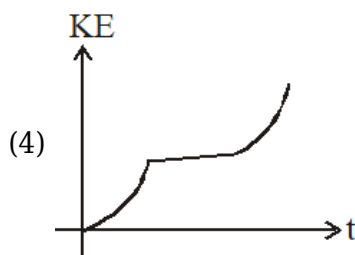
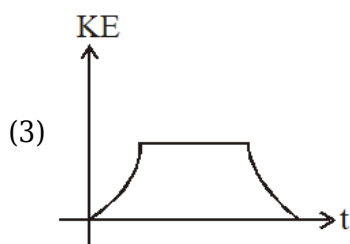
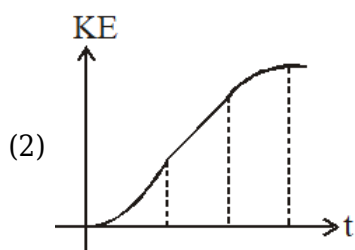
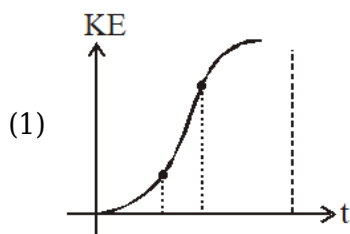
(3) $F_1 = 20$ N, $F_2 = 20$ N

(4) $F_1 = 15$, $F_2 = 15$

30) For the following (a - t) graph, the (KE - t) graph will be (assuming $v = 0$ at $t = 0$). The particle



is moving on straight line :



PART-II : CHEMISTRY

1) Which of the following order is correct against mentioned properties ?

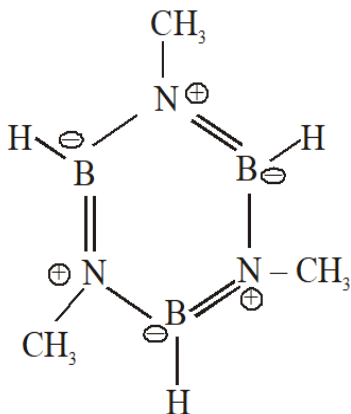
(1) $P^{3-} < S^{2-} < Cl^-$ (Ionic size)

(2) $He^+ < H^+ < H^-$ (Ionic size)

(3) $Se < O < S$ (Electron affinity)

(4) $Cr = Fe = Zn$ (Number of fully vacant orbitals up to shell having highest principal quantum number)

2) Which of the following statement is correct for below compound ?



- (1) All the atoms are in same plane
- (2) Maximum number of H atoms may lie in same plane is 6
- (3) All B, C & N atoms are sp^2 hybridised
- (4) Nodal plane of p bonds are perpendicular to the plane of hexagonal ring

3) When excess of ammonia reacts with chlorine gives :

- (1) $NH_4Cl + HCl$
- (2) $N_2 + NCl_3$
- (3) $HCl + NCl_3$
- (4) $NH_4Cl + N_2$

4) A, B and C are three complex of chromium (III) with empirical formula $H_{12}O_6Cl_3Cr$. All the three complexes have water and chloride ions. Complex A does not react with con. H_2SO_4 , whereas complex B and C lose 6.7% and 13.5% of their original weight respectively. On treatment with concentrated H_2SO_4 , identify the correct set of A, B and C.

- (1) $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$ $[Cr(H_2O)_4Cl]Cl_2 \cdot 2H_2O$
- (2) $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$ $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$
- (3) $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_6]Cl_2 \cdot 2H_2O$ $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$
- (4) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$, $[Cr(H_2O)_6]Cl_3$ $[Cr(H_2O)_5Cl]Cl_2 \cdot 2H_2O$

5) Read the following statements:

- (I) In the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6) mixed with fluorspar (CaF_2), cryolite and fluorspar are used to decrease the M.P. and increase the conductivity of the electrolyte
 - (II) Leaching is a method to dissolve Al_2O_3 from red bauxite.
 - (III) The conversion of PbS into Pb requires roasting and self reduction.
 - (IV) Sodium can be extracted by the electrolytic-reduction of aqueous sodium chloride.
- Pick the correct set of statements.

- (1) I, II
- (2) I, III, IV
- (3) II, III, IV
- (4) I, II, III

6) Which of the following statement is not correct for the solution obtained, when s-block metals dissolved in liquid NH_3 ?

- (1) It imparts deep blue colour
- (2) Freshly prepared solution is paramagnetic in nature
- (3) It is good conductor due to presence of ammoniated electrons only
- (4) It shows reducing nature

7) Which of the following is/are not a common characteristics properties of transition elements ?

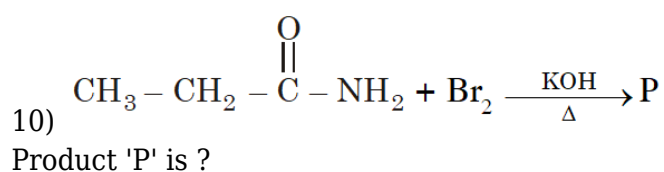
- (1) Formation of interstitial compounds
- (2) Imparts different characteristics colours to oxidising flame
- (3) Irregular trend in ionisation energy & radius in a series
- (4) Catalytic properties

8) Which of the following statement is correct about H_2O_2 ?

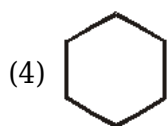
- (1) H_2O_2 is used in detection of Cr^{+3} and Ti^{+4} ion
- (2) H_2O_2 is used as a rocket propellant
- (3) H_2O_2 is a odourless liquid
- (4) All are correct

9) Which of the following oxidising agent is most suitable for below reaction ?

- (1) PCC
- (2) $\text{K}_2\text{Cr}_2\text{O}_7$
- (3) KMnO_4
- (4) All



- (1) $\text{CH}_3 - \text{CH}_3$
- (2) $\text{CH}_3 - \text{CH}_2 - \text{NH}_2$
- (3) $\text{CH}_2 = \text{CH}_2$



11) The cationic detergent that is used in hair conditioner is :

- (1) Sodium dodecyl benzene sulphonate
- (2) Sodium lauryl sulphate

(3) Cetyltrimethyl ammonium bromide

(4) Sodium stearyl sulphate

12) Bakelite is obtained from phenol by reacting with

(1) $(\text{CH}_2\text{OH})_2$

(2) CH_3CHO

(3) $\text{CH}_3\text{-COCH}_3$

(4) HCHO

13) Which of the following process is not good for the preparation of open chain alkane having odd number of carbons ?

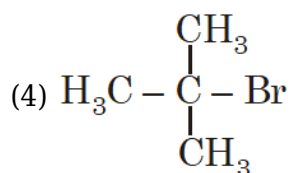
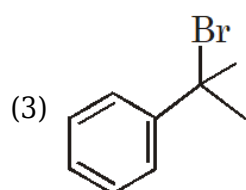
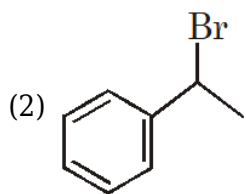
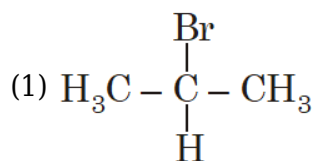
(1) Wurtz process

(2) Kolbe electrolysis

(3) Corey house synthesis

(4) Both (1) & (2)

14) Which of the following compounds is most reactive for Wurtz reaction ?



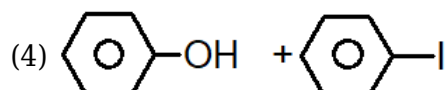
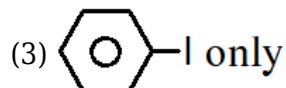
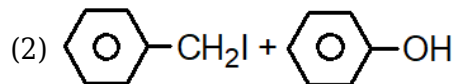
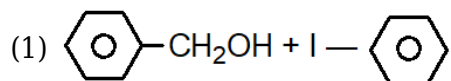
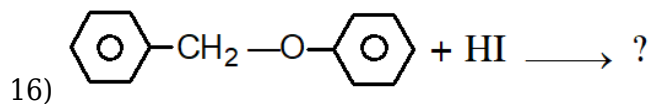
15) The reagent that brings about the conversion of (R)-butan-2-ol to (R)-2-chlorobutane is :

(1) SOCl_2

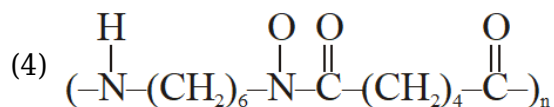
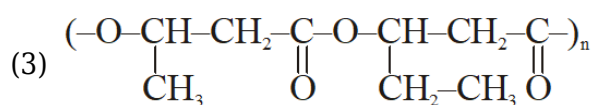
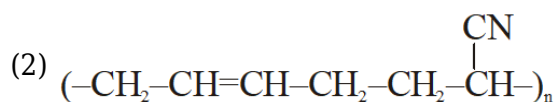
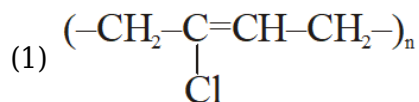
(2) PCl_5

(3) PCl_3

(4) All of them



17) Which of the following polymer is biodegradable ?



18) The tetrahedral voids formed by ccp arrangement of Cl^- ions in rock salt structure are

- (1) Occupied by Na^+ ions
- (2) Occupied by Cl^- ions
- (3) Occupied by either Na^+ or Cl^- ions
- (4) Vacant

19) At a certain temperature pure liquid A and liquid B have vapour pressures 10 and 37 torr respectively. For a certain ideal solution of A and B, the vapours in equilibrium with the liquid has the components A and B in the partial pressure ratio $p_A : p_B = 1 : 7$. The mole fraction of A in the solution are

- (1) 0.345
- (2) 0.654
- (3) 0.5
- (4) 0.8

20) The relation between solubility (S) and solubility product (K_{sp}) of a partially soluble binary electrolyte is

(1) $S = \frac{1}{3} \sqrt{K_{sp}}$

(2) $S = \sqrt{K_{sp}}$

(3) $S = K_{sp}$

(4) $S = \frac{K_{sp}}{2}$

21) The space in the dry cell is filled with

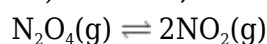
(1) Paste of KOH and ZnO

(2) MnO_2 , $ZnCl_2$, a filter

(3) MnO_2 , $ZnCl_2$, NH_4Cl and a filter

(4) $MnCl_2$, $ZnCl_2$, NH_4Cl and filter

22) At 298 K, the equilibrium between N_2O_4 and NO_2 is represented as :



If the total pressure of the equilibrium mixture is P and the degree of dissociation of $N_2O_4(g)$ at 298 K is x, the partial pressure of $NO_2(g)$ under these conditions is

(1) $\left(\frac{2x}{1+x} \right) P$

(2) $2xP$

(3) $\left(\frac{2x}{1-x} \right) P$

(4) $\frac{2}{3}xP$

23) In which of the following case rise in temperature would be maximum on mixing ?

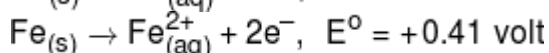
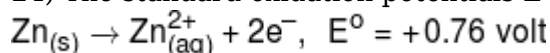
(1) 100 ml 1M HCl + 100 ml 1 M NaOH

(2) 50 ml 1M H_2SO_4 + 100 mL 1 N $Ba(OH)_2$

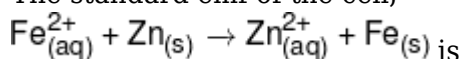
(3) 50 ml 1N H_2SO_4 + 100 mL 1 M $Ba(OH)_2$

(4) 100 ml 1N H_2SO_4 + 100 mL 1 N $Ba(OH)_2$

24) The standard oxidation potentials E° , for the half reactions are as :



The standard emf of the cell,



(1) 0.35 volt

(2) - 0.35 volt

(3) +1.17 volt

(4) - 1.17 volt

25) The volume of a colloidal particle V_c , volume of a solute particle in a true solution V_t , the volume of suspension particle is V_s can be arranged

(1) $V_c = V_t = V_s$

(2) $V_s < V_c < V_t$

(3) $V_s > V_c > V_t$

(4) $V_c > V_s > V_t$

26) The ratio $\frac{a}{b}$ (the terms used in vander Waal's equation) has the unit :

(1) atm litre mol⁻¹

(2) atm dm³ mol⁻¹

(3) dyne cm mol⁻¹

(4) All of these

27) Although nitrogen does not adsorb on surface at room temperature, it adsorbs on surface at 83K. Which one of the following statements is correct ?

(1) At 83K, there is formation of monomolecular layer

(2) At 83K, there is formation of multimolecular layer

(3) At 83K, nitrogen molecules are held by chemical bonds

(4) At 83K, nitrogen is adsorbed as atoms

28) For the decomposition of N_2O_5 , it is given that $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$, activation energy(E_a)

$N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2$, activation energy (E_a')

(1) $E_a' > E_a$

(2) $E_a' < E_a$

(3) $E_a' = E_a$

(4) $E_a = 2E_a'$

29) If 0.5 mol of $BaCl_2$ is mixed with 0.1 mole of Na_3PO_4 , the maximum number of mole of $Ba_3(PO_4)_2$ that can be formed is :

(1) 0.7

(2) 0.05

(3) 0.30

(4) 0.10

30) From the α -particle scattering experiment, Rutherford concluded that except

- (1) α -particle can come within a distance of the order of 10^{-14} m of the nucleus
- (2) The radius of the nucleus is less than 10^{-14} m
- (3) Scattering follows Coulomb's law
- (4) The positively charged parts of the atom move with extremely high velocity

PART-III : MATHEMATICS

1) For $Z_1 = \sqrt[6]{\frac{1-i}{1+i\sqrt{3}}}$; $Z_2 = \sqrt[6]{\frac{1-i}{\sqrt{3}+i}}$;
 $Z_3 = \sqrt[6]{\frac{1+i}{\sqrt{3}-i}}$ which of the following holds good?

- (1) $\sum |Z_1|^2 = \frac{3}{2}$
- (2) $|Z_1|^4 + |Z_2|^4 = |Z_3|^{-8}$
- (3) $\sum |Z_1|^3 + |Z_2|^3 = |Z_3|^{-6}$
- (4) $|Z_1|^4 + |Z_2|^4 = |Z_3|^8$

2) The common tangent of two parabolas $y = x^2$ and $y = x^2 - 2x + 2$ is -

- (1) $y = 2x - 1$
- (2) $4y - x + 4 = 0$
- (3) $4x - 4y - 1 = 0$
- (4) $y + 4x + 4 = 0$

3) If z is complex number then, $\frac{z [|z|^2 - 1] + 2 \operatorname{Re}(z)}{|z|^2}$ is equal to :

- (1) $z - \frac{1}{z}$
- (2) $z + \frac{1}{z}$
- (3) $\operatorname{Re}(z)$
- (4) None of these

4) Consider the lines $2x + 3y = 7$, $2x + 3y = 12$ and point $A(3, -5)$. Then -

- (1) A lies between the lines
- (2) Sum of perpendicular distance from A to the lines = $5/\sqrt{13}$
- (3) Distance between lines is $19/\sqrt{13}$
- (4) None of these

5) The angle of intersection between the curves

$$y = \int_0^{x^3} (\sqrt{5-t^2}) dt \quad \text{and x-axis is (where } x \neq 0) -$$

- (1) $\tan^{-1} \frac{1}{2}$
- (2) $\cot^{-1} 2$
- (3) $\cot^{-1} \frac{1}{2}$
- (4) $\sin^{-1} \left(\frac{1}{\sqrt{5}} \right)$

6) Consider the lines $L_1: (\lambda - 3)x + (\mu + 3)y = a$, $L_2: (\mu - 3)x + (\lambda + 3)y = a$, then -

- (1) L_1 and L_2 are coincident for $\lambda^2 - \mu^2 = 0$
- (2) L_1 and L_2 are parallel but not coincident for $\lambda^2 - \mu^2 = 0$
- (3) L_1 and L_2 are perpendicular for $\lambda\mu = 9$
- (4) L_1 and L_2 are perpendicular for $\lambda\mu = -9$

$$7) \text{ If } f(x) = \frac{1}{x^2} \int_4^x \{4t^2 - 2F'(t)\} dt, \text{ then } F'(4) \text{ equals :}$$

- (1) $\frac{32}{9}$
- (2) $\frac{64}{3}$
- (3) $\frac{64}{9}$
- (4) None of these

8) If the vector $\vec{b}$ is collinear with the vector $\vec{a} = [2\sqrt{2}, -1, 4]$ & $|\vec{b}| = 10$, then :

- (1) $\vec{a} \pm \vec{b} = 0$
- (2) $\vec{a} \pm 2\vec{b} = 0$
- (3) $2\vec{a} \pm \vec{b} = 0$
- (4) None

$$9) \text{ If } f(x) \text{ is a differentiable function in } (0, 4), \text{ then } \int_0^4 f(x) dx \text{ is equal to -}$$

- (1) $2f(c)$ for some $c \in (0,4)$
- (2) $4cf(c^2)$ for some $c \in (0,2)$
- (3) $4f(c^2)$ for some $c \in (0,2)$

(4) $f(c)$ for some $c \in (0,4)$

10) The angle between $\vec{a}$ and $\vec{b}$ is $\pi/6$, then angle between $2\vec{a}$ and $3\vec{b}$ is -

(1) $\pi/3$

(2) $\pi/2$

(3) $\pi/6$

(4) None of these

11) If $px^4 + qx^3 + rx^2 + sx + t$

$$\equiv \begin{vmatrix} x^2 + 3x & x - 1 & x + 3 \\ x + 1 & 2 - x & x - 3 \\ x - 3 & x + 4 & 3x \end{vmatrix} \text{ then } t =$$

(1) 33

(2) 0

(3) 21

(4) None

12) If $A(\cos \alpha, \sin \alpha)$, $B(\sin \alpha, -\cos \alpha)$, $C(1,2)$ are the vertices of a ΔABC , then as α varies, the locus of its centroid is -

(1) $x^2 + y^2 - 2x - 4y + 3 = 0$

(2) $x^2 + y^2 - 2x - 4y + 1 = 0$

(3) $3(x^2 + y^2) - 2x - 4y + 1 = 0$

(4) None of these

13) Water is drained from a vertical cylindrical tank by opening a valve at the base of the tank. It is known that the rate at which the water level drops is proportional to the square root of water depth y , where the constant of proportionality $k > 0$ depends on the acceleration due to gravity and the geometry of the hole. If t is measured in minutes and $k = 1/15$ then the time to drain the tank if the water is 4 meter deep to start with is -

(1) 30 min

(2) 45 min

(3) 60 min

(4) 80 min

14) The equation of the locus of a point which moves such that its distance from the point $(a\lambda, 0)$ is λ times its distance from the point $(\frac{a}{\lambda}, 0)$ ($\lambda \neq \pm 1$) is (where a is constant) :-

(1) $x^2 - y^2 = a^2$

(2) $2x^2 - y^2 = 2a^2$

(3) $xy = a^2$

(4) $x^2 + y^2 = a^2$

15) The algebraic sum of ordinates of points of contact of the tangents drawn from the point $(-2, 3)$ to the parabola $y^2 = 8x$ is -

- (1) 6
- (2) 8
- (3) 10
- (4) 8.5

16) $\lim_{x \rightarrow -\infty} \frac{x^5 \sin\left(\frac{1}{\pi x^2}\right) + 3|x|^2 + 70}{|x|^3 + 7|x| + 18}$ is equal to -

- (1) $-\frac{1}{\pi}$
- (2) 0
- (3) ∞
- (4) None of these

17) If $y = (A + Bx) e^{mx} + (m - 1)^{-2} e^x$ then $\frac{d^2y}{dx^2} - 2m \frac{dy}{dx} + m^2 y$ is equal to :

- (1) e^x
- (2) e^{mx}
- (3) e^{-mx}
- (4) $e^{(1-m)x}$

18) $f : (-\infty, 1] \rightarrow \left[\frac{1}{2}, \infty\right)$, where $f(x) = 2^{x(x-2)}$, then $f^{-1}(x)$ is given by -

- (1) $1 - \sqrt{1 + \log_2 x}$
- (2) $1 - \sqrt{1 - \log_2 x}$
- (3) $1 + \sqrt{1 + \log_2 x}$
- (4) $1 + \sqrt{1 - \log_2 x}$

19) A function whose graph is symmetrical about the origin is given by -

- (1) $f(x) = e^x + e^{-x}$
- (2) $f(x) = \sin(\sin(\cos(\sin x)))$
- (3) $f(x + y) = f(x) + f(y)$
- (4) $\sin x + \sin|x|$

20) If the distance of a point on the ellipse $\frac{x^2}{6} + \frac{y^2}{2} = 1$ from the centre is 2, then the eccentric angle is-

- (1) $\pi/3$
- (2) $\pi/4$
- (3) $\pi/6$
- (4) $\pi/2$

21) A variable point P moves such that the chord of contact of the pair of tangent drawn to

hyperbola $\frac{x^2}{16} - y^2 = 1$ always parallel to its tangent at $(5, 3/4)$. The locus of P is a -

- (1) Straight line
- (2) Circle
- (3) Parabola
- (4) Ellipse

22) If $\int_a^x ty(t)dt = x^2 + y(x)$ then y as a function of x is-

- (1) $y = 2 - (2 + a^2) e^{\frac{x^2 - a^2}{2}}$
- (2) $y = 1 - (2 + a^2) e^{\frac{x^2 - a^2}{2}}$
- (3) $y = 2 - (1 + a^2) e^{\frac{x^2 - a^2}{2}}$
- (4) None

23) A rectangular hyperbola of latus rectum 2 units passes through $(0, 0)$ and has $(1, 0)$ as its one focus. The locus of other focus is

- (1) $4x^2 + y^2 = 1$
- (2) $x^2 + y^2 = 9$
- (3) $x^2 - y^2 = 1$
- (4) $4x^2 - y^2 = 1$

24) The product of all the values of α for which equations $(a - \alpha)x + by + c = 0$, $cx + (a - \alpha)y + b = 0$ and $bx + cy + a - \alpha = 0$ are consistent, when $a, b, c > 0$, is -

- (1) Zero
- (2) Positive
- (3) Negative
- (4) One

25) Variable circles are drawn touching two fixed circles externally, then locus of centre of variable circle is-

- (1) Parabola
- (2) Ellipse

(3) Hyperbola

(4) Circle

26) The value of $\int_{-3}^3 x^{101} \cos x dx =$

(1) 0

(2) 3^{101}

(3) 3^{-101}

(4) 2

27) Let A be a diagonal matrix of order 4 and $t_r(A) = 8$. If all diagonal entries are positive, then maximum value of $\det(A)$ is -

(1) 16

(2) 8

(3) 4

(4) 1

28) Let for every integer a, $\int_a^{a+1} f(x) dx = a^2$, then the value of $\int_{-2}^4 f(x) dx$ is equal to -

(1) 16

(2) 17

(3) 18

(4) 19

29) Let matrix $A = [a_{ij}]_{3 \times 3}$ be such that , then matrix A is -

(1) Skew-symmetric

(2) Symmetric

(3) Singular

(4) None of these

30) If A, B & A + B are non singular matrices of same order, then $A(A(A + B)^{-1}B)^{-1}B$ is equal to -

(1) AB

(2) A - B

(3) A + B

(4) $A^{-1} + B^{-1}$

31) The centre of the circle passing through (0, 0), (1, 0) & touching the circle $x^2 + y^2 = 9$ is -

$$(1) \left(\frac{1}{2}, \sqrt{2} \right)$$

$$(2) \left(\frac{1}{2}, \frac{3}{\sqrt{2}} \right)$$

$$(3) \left(\frac{3}{2}, \frac{1}{\sqrt{2}} \right)$$

$$(4) \left(\frac{1}{2}, -\frac{1}{\sqrt{2}} \right)$$

32) If one root of the equations $ax^2 + bx + c = 0$ and $bx^2 + cx + a = 0$ is common, then the value of $\left(\frac{a^3 + b^3 + c^3}{abc} \right)^2$ is -

$$(1) 1$$

$$(2) 3$$

$$(3) 9$$

$$(4) 16$$

33) The value of $1 + ({}^1C_0 + {}^1C_1) + ({}^2C_0 + {}^2C_1 + {}^2C_2) + ({}^3C_0 + {}^3C_1 + {}^3C_2 + {}^3C_3) + \dots + ({}^{n-1}C_0 + {}^{n-1}C_1 + \dots + {}^{n-1}C_{n-1})$ is -

$$(1) {}^nC_0 + {}^nC_1 + {}^nC_2 + \dots + {}^nC_n$$

$$(2) {}^nC_1 + {}^nC_2 + \dots + {}^nC_n$$

$$(3) 2n$$

$$(4) 2\{{}^{n-1}C_0 + {}^{n-1}C_1 + {}^{n-1}C_2 + \dots + {}^{n-1}C_{n-1}\}$$

34) If $(1+x-2x^2)^6 = 1 + C_1x + C_2x^2 + C_3x^3 + \dots + C_{12}x^{12}$, then the value of $C_2 + C_4 + C_6 + \dots + C_{12}$ is -

$$(1) 30$$

$$(2) 32$$

$$(3) 31$$

$$(4) \text{None of these}$$

35) If

$${}^nC_r + 5{}^nC_{r+1} + 10{}^nC_{r+2} + 10{}^nC_{r+3} + 5{}^nC_{r+4} + {}^nC_{r+5} = {}^{n+k}C_{r+k}, \text{ then the value of } k \text{ can be -}$$

$$(1) 1$$

$$(2) 2$$

$$(3) 4$$

$$(4) 5$$

36) If α & β are the roots of the equation $x^2 + 6x + \lambda = 0$ and $3\alpha + 2\beta = -20$, then λ is equal to -

$$(1) -8$$

(2) -16

(3) 16

(4) 8

37) If $\sin(\pi \cos \theta) = \cos(\pi \sin \theta)$, then $\cos\left(\theta \pm \frac{\pi}{4}\right)$ is equal to -

(1) $\cos \frac{\pi}{4}$

(2) $\frac{1}{2} \cos \frac{\pi}{4}$

(3) $\cos \frac{\pi}{8}$

(4) None of these

38) If $(1 + \tan 1^\circ)(1 + \tan 2^\circ)(1 + \tan 3^\circ) \dots (1 + \tan 45^\circ) = 2^n$, then n is equal to -

(1) 21

(2) 22

(3) 23

(4) 24

39) If common ratio of a geometric progression is positive then maximum value of the ratio of second term to the sum of first 3 terms equals -

(1) 2

(2) $\frac{1}{3}$

(3) 3

(4) $\frac{1}{2}$

40) Tangents at points (1,4) & (4,-8) to a parabola intersect at point (-2,-2). The slope of axis of the parabola is -

(1) 0

(2) -1

(3) 1

(4) $\frac{1}{2}$

PART-IV(A) : English Proficiency

1) Read the following active sentences and mark the correct passive sentence of it from the below given options :

I bade her sing in the car.

(1) I bid her sing in the car

- (2) She was bidden sing in the car
- (3) I bid her to sing in the car
- (4) She was bidden to sing in the car

2) Read the following active sentences and mark the correct passive sentence of it from the below given options :

Her dedication has impressed the bosses.

- (1) Her dedication has been impressing to bosses.
- (2) The bosses have been impressed with her dedication.
- (3) The bosses are impressed with her dedication.
- (4) Her dedication is impressive to the bosses.

3) Read the following phrases and mark the option that explains it the best :
The belief that nothing has meaning or value.

- (1) Nihilism
- (2) Namesake
- (3) Nautical
- (4) Nemesis

4) Read the following phrases and mark the option that explains it the best :
Small objects kept for decoration.

- (1) Bourgeois
- (2) Bivouac
- (3) Bric-a-brac
- (4) Boulevard

5) Read the following passage carefully and mark the correct answer for the questions given below :

he happy man is the man who lives objectively, who has free affections and wide interests, who secures his happiness through these interests and affections and through the fact that they, in turn, make him an entity of interest and fondness to many others. To be the recipient of affection is a potent cause of happiness, but the man who demands affection is not the man upon whom it is bestowed. The man who receives liking is, speaking generally, the man who gives it. But it is useless to attempt to give it as a calculation, in the way in which one might lend money at interest, for a calculated affection is not honest and is not felt to be so by the beneficiary. What then can a man do who is doomed because he is enclosed in self? So long as he continues to think about the causes of his unhappiness, he continues to be self-centred and therefore does not get outside it. It must be of genuine interest, not by simulated interests adopted merely as a medicine. Although this difficulty is real, there is never the less much that he can do if he has rightly diagnosed his trouble. If for instance, his woe is due to a sense of depravity, conscious or unconscious, he can first influence his conscious mind that he has no reason to feel sinful, and then proceed, to plant this rational conviction in his unconscious mind, concerning himself meanwhile with some more or less neutral activity. If he prospers in dismissing the sense of immorality, it is

possible that genuine unbiased interests will arise spontaneously. If his trouble is self-pity, he can deal with it in the same manner after first persuading himself that there is nothing extraordinarily unfortunate in his circumstances. If fright is his worry, let him drill exercises designed to give bravery. Courage has been recognized from time immemorial as an important virtue, and a great part of the training of boys and young men has been devoted to producing a type of character capable of fearlessness in battle. But moral courage and intellectual courage have been much less studied. They also, however, have their technique. Admit to yourself every day at least one painful truth, you will find it quite useful. Teach yourself to feel that life would still be worth living even if you were not, as of course, you are, immeasurably superior to all your friends in virtue and in intelligence. Exercises of this kind protracted through numerous years will, at last, enable doing, might free you from the empire of fear on a very large scale.

According to the passage, a happy man

- (1) Is self-engaged
- (2) Has free affection and wide interests
- (3) Is free from outward passions
- (4) Has no grudge

6) Read the following passage carefully and mark the correct answer for the question given below :

he happy man is the man who lives objectively, who has free affections and wide interests, who secures his happiness through these interests and affections and through the fact that they, in turn, make him an entity of interest and fondness to many others. To be the recipient of affection is a potent cause of happiness, but the man who demands affection is not the man upon whom it is bestowed. The man who receives liking is, speaking generally, the man who gives it. But it is useless to attempt to give it as a calculation, in the way in which one might lend money at interest, for a calculated affection is not honest and is not felt to be so by the beneficiary. What then can a man do who is doomed because he is enclosed in self? So long as he continues to think about the causes of his unhappiness, he continues to be self-centred and therefore does not get outside it. It must be of genuine interest, not by simulated interests adopted merely as a medicine. Although this difficulty is real, there is never the less much that he can do if he has rightly diagnosed his trouble. If for instance, his woe is due to a sense of depravity, conscious or unconscious, he can first influence his conscious mind that he has no reason to feel sinful, and then proceed, to plant this rational conviction in his unconscious mind, concerning himself meanwhile with some more or less neutral activity. If he prospers in dismissing the sense of immorality, it is possible that genuine unbiased interests will arise spontaneously. If his trouble is self-pity, he can deal with it in the same manner after first persuading himself that there is nothing extraordinarily unfortunate in his circumstances. If fright is his worry, let him drill exercises designed to give bravery. Courage has been recognized from time immemorial as an important virtue, and a great part of the training of boys and young men has been devoted to producing a type of character capable of fearlessness in battle. But moral courage and intellectual courage have been much less studied. They also, however, have their technique. Admit to yourself every day at least one painful truth, you will find it quite useful. Teach yourself to feel that life would still be worth living even if you were not, as of course, you are, immeasurably superior to all your friends in virtue and in intelligence. Exercises of this

kind protracted through numerous years will, at last, enable doing, might free you from the empire of fear on a very large scale.

Which of the following statements is NOT TRUE in the context of the passage ?

- (1) The happy man has wide interests
- (2) Courage has been recognized as an important virtue
- (3) A happy man does not demand affection
- (4) Moral courage and intellectual courage has been extensively studied

7) Read the following passage carefully and mark the correct answer for the question given below:

The happy man is the man who lives objectively, who has free affections and wide interests, who secures his happiness through these interests and affections and through the fact that they, in turn, make him an entity of interest and fondness to many others. To be the recipient of affection is a potent cause of happiness, but the man who demands affection is not the man upon whom it is bestowed. The man who receives liking is, speaking generally, the man who gives it. But it is useless to attempt to give it as a calculation, in the way in which one might lend money at interest, for a calculated affection is not honest and is not felt to be so by the beneficiary. What then can a man do who is doomed because he is enclosed in self? So long as he continues to think about the causes of his unhappiness, he continues to be self-centred and therefore does not get outside it. It must be of genuine interest, not by simulated interests adopted merely as a medicine. Although this difficulty is real, there is never the less much that he can do if he has rightly diagnosed his trouble. If for instance, his woe is due to a sense of depravity, conscious or unconscious, he can first influence his conscious mind that he has no reason to feel sinful, and then proceed, to plant this rational conviction in his unconscious mind, concerning himself meanwhile with some more or less neutral activity. If he prospers in dismissing the sense of immorality, it is possible that genuine unbiased interests will arise spontaneously. If his trouble is self-pity, he can deal with it in the same manner after first persuading himself that there is nothing extraordinarily unfortunate in his circumstances. If fright is his worry, let him drill exercises designed to give bravery. Courage has been recognized from time immemorial as an important virtue, and a great part of the training of boys and young men has been devoted to producing a type of character capable of fearlessness in battle. But moral courage and intellectual courage have been much less studied. They also, however, have their technique. Admit to yourself every day at least one painful truth, you will find it quite useful. Teach yourself to feel that life would still be worth living even if you were not, as of course, you are, immeasurably superior to all your friends in virtue and in intelligence. Exercises of this kind protracted through numerous years will, at last, enable doing, might free you from the empire of fear on a very large scale.

A man who is suffering from the feeling of self-pity should

- (1) Develop a feeling of fearlessness
- (2) Persuade himself that everything is alright in his circumstances
- (3) Control his passions and emotions
- (4) Seek affection from others

8) The following sentences are broken into four parts labelled as (A), (B), (C), and (D). You need to arrange these jumbled parts in a way that they form a meaningful sentence. Mark the correct combination as the answer:

Some automobile drivers and passengers

- (a) Person's decision whether or not to wear a seat belt.
- (b) As a result, they conclude that it should be each
- (c) The people do not harm others as a result of taking the risks.
- (d) Argues that people have the right to take risks as long as

- (1) bacd
- (2) dcba
- (3) cbad
- (4) acdb

9) The following sentences are broken into four parts labelled as (A), (B), (C), and (D). You need to arrange these jumbled parts in a way that they form a meaningful sentence. Mark the correct combination as the answer:

To prevent some conflicts of interest,

- (a) For three years after such officials leave the government service.
- (b) One such official concluded, however, that such a prohibition would be unfortunate
- (c) The BJP could prohibit high-level government officials from accepting positions as lobbyists
- (d) Because it would prevent high-level government officials from earning a livelihood for three years.

- (1) cabd
- (2) bcad
- (3) abdc
- (4) cdba

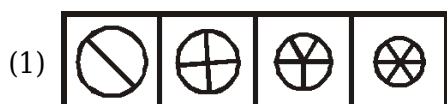
10) Read the following question and find out the error of parallel structure in the underlined part :
Playing video games, unlike watching television, is not a passive activity, because doing so requires that the video game player react to what's happening onscreen, strategizes to overcome obstacles, and persevere to advance through the most difficult stages of the game.

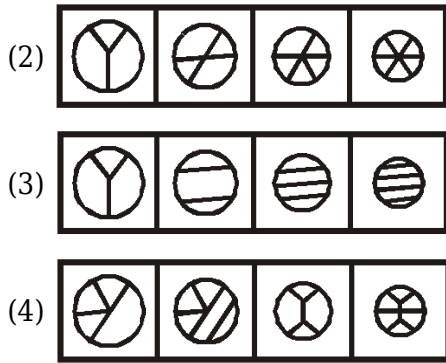
- (1) That she strategizes
- (2) That she strategize
- (3) Strategize
- (4) No change

PART-IV(B) : Logical Reasoning

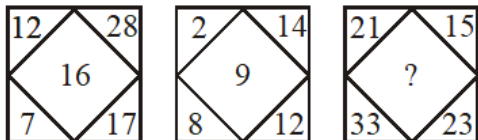
1) Identify the set of figures which follows the given rule.

Rule: The circle decreases in size and its sectors increase in number.





2) Select the correct option to replace the question mark in the given figure.



- (1) 20
- (2) 24
- (3) 23
- (4) 25

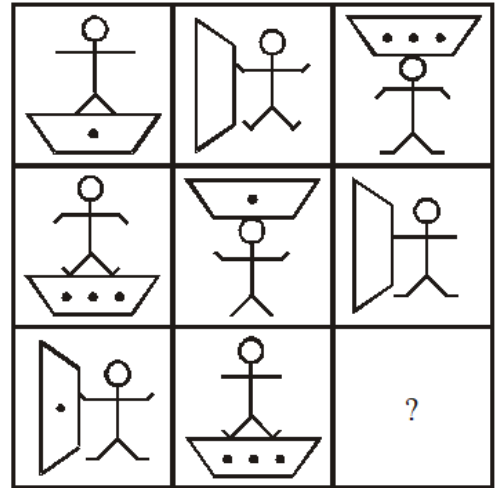
3) Read the given paragraph carefully and select the suitable option to answer which assumptions are correct.

Statement: Use of mobile phone has become one of the reasons which make children stay away from the playgrounds. Children don't play outdoor sports; instead they prefer playing digital games staying indoors. This not only affects their eye sight, but also slows down their physical development. Sports help us maintain physical fitness and increase our immunity to fight against many diseases. Sports make us learn team work and a better conflict management.

Assumptions:

- I. Sports help us learn some important professional skills.
- II. Sports are very important to maintain a good mental health.
- III. Children prefer to play outdoor games on mobile phone.

- (1) Only I is implicit
- (2) Only I and II are implicit
- (3) Only II and III are implicit
- (4) All, I, II and III are implicit



4) Identify the figure that completes the given figure matrix.

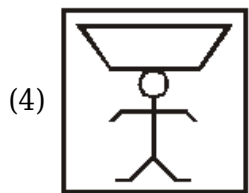
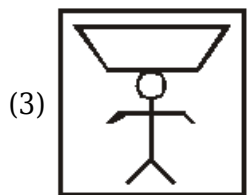
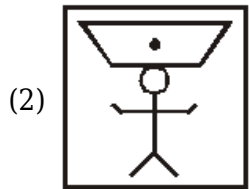
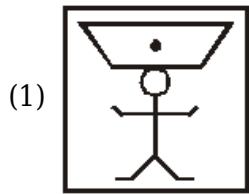
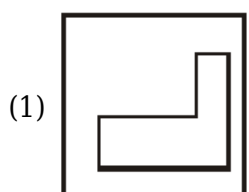
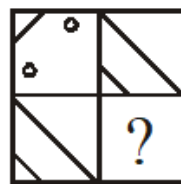
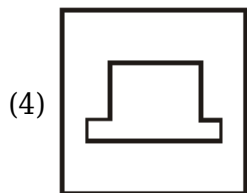
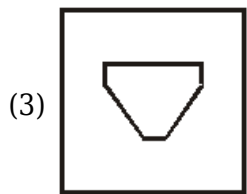
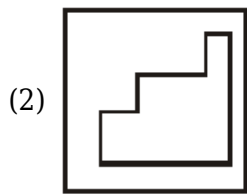


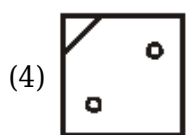
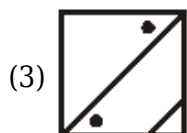
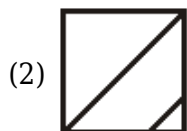
Fig. X

5) Identify the figure that can be formed by the pieces given in the figure X.





6) Choose the figure to complete the given pattern.



7) Identify the figure (out of Figures A, B C and D) that most closely resembles the unfolded for of the figure Z (after cutting out the shaded part out of it).

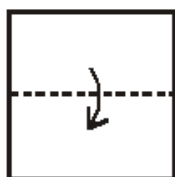


Fig. V

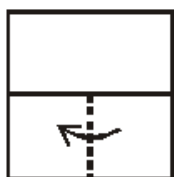


Fig. W

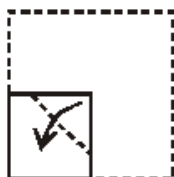


Fig. X



Fig. Y

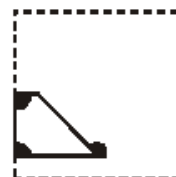
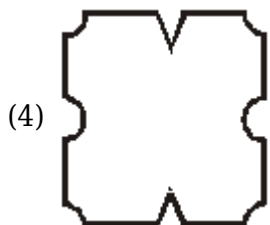
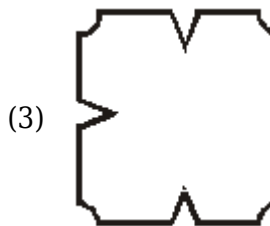
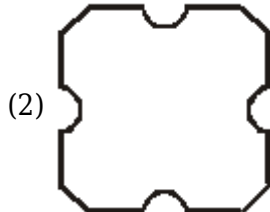
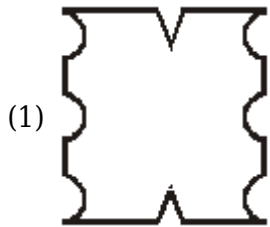
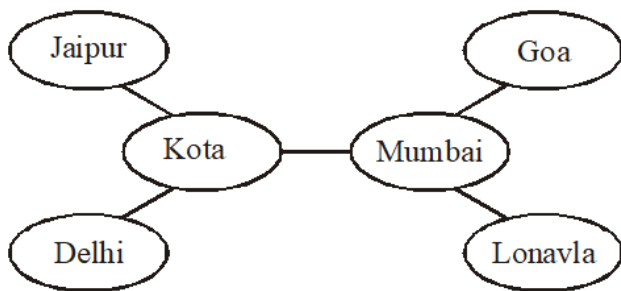


Fig. Z



8) Study the given map of rail connectivity between various cities in India and then choose the correct option to replace the question mark in the given analogy.



Kota : Jaipur :: Mumbai : ?

- (1) Jaipur
- (2) Kota
- (3) Delhi
- (4) None of the above

9) Choose the correct option to replace the question mark in the given series.
A6E, S42W, H20L, O34S, ?

- (1) F15I
- (2) J25O
- (3) M4Q

(4) V48Z

10) Choose the word which is different from the rest in the given group.

Orange, Lime, Grapefruit, Watermelon, Kabosu

(1) Lime

(2) Kabosu

(3) Watermelon

(4) None of the above

11)

Z1	Z16	V49
A4	C25	?
T9	R36	P81

(1) E10

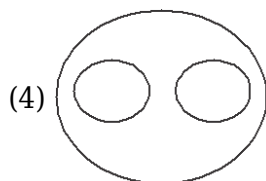
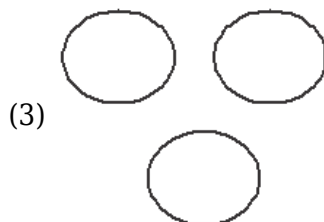
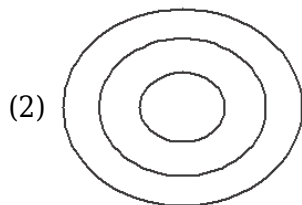
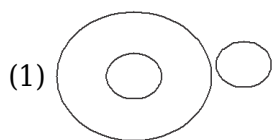
(2) S15

(3) E64

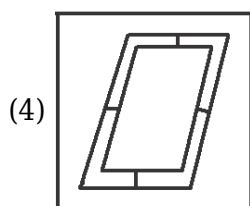
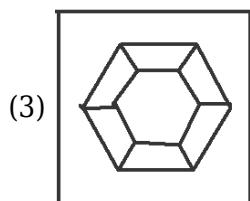
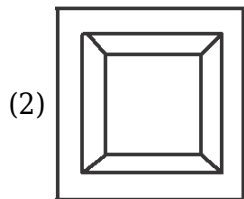
(4) S12

12) **Direction:** Which of the following diagrams correctly represents the relation between given three words.

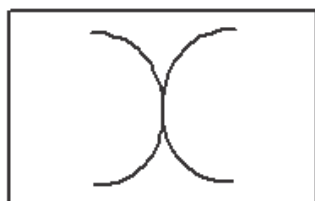
SEED, LEAF, ROOT



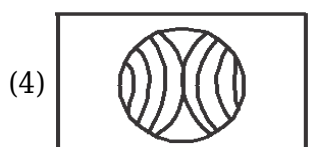
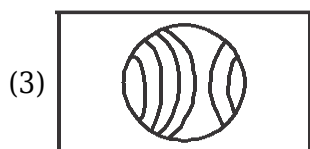
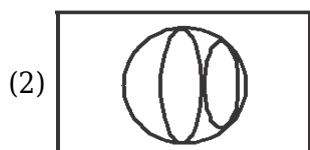
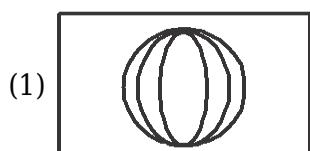
13) **Direction:** Among five figures four figures are similar in a certain way. Find the different figure



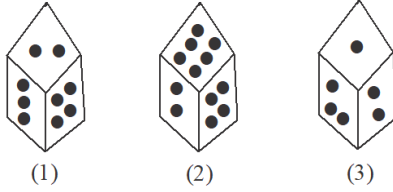
14) **Direction:** Figure is embedded in one of the answer figures. Find the correct one in which it is



embedded.



15) Given below are three different positions of dice. Find the number of dots on the face to opposite



the face bearing (C) three dots?

- (1) 1
- (2) 5
- (3) 6
- (4) None

16) Mahesh walks 20 meters towards North. He then turns left and walks 40 meters. He again turns left and walks 20 meters. Further he moves 20 metres after turning to the right. How far is he from his original position?

- (1) 20 m
- (2) 30 m
- (3) 50 m
- (4) 60 m

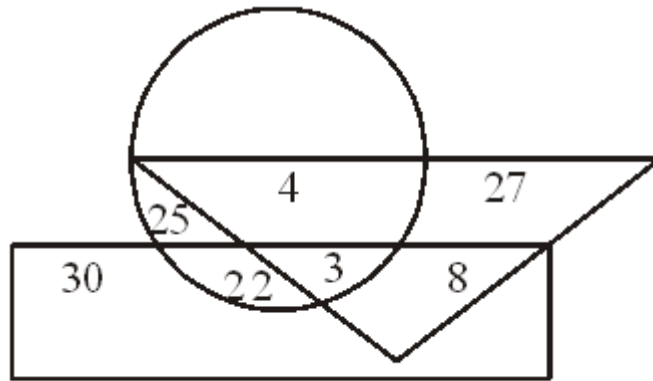
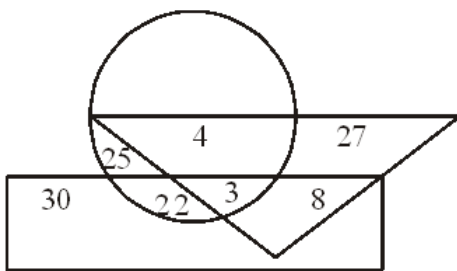
17) Find which one word cannot be made from the letters of the given word: INTERNATIONAL

- (1) ORIENTAL
- (2) TERMINAL
- (3) LATTER
- (4) RATIONAL

18) If $\cdot$ means $\div$, $\times$ means $-$, $-$ means $\times$, $\div$ means $+$ and $+$ means $\div$, then $(3 - 15 \div 19) \times 8 + 6 = ?$

- (1) 8
- (2) 4
- (3) 2
- (4) -1

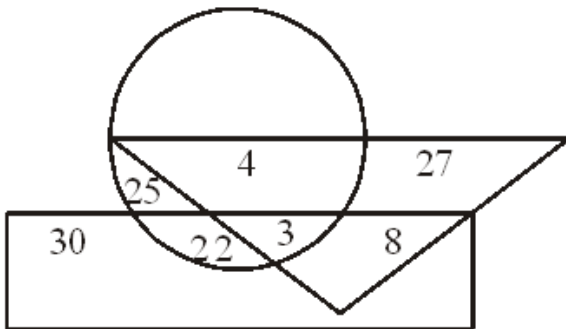
19) **Direction:-** Study the following figure carefully and answer the questions given below it. The rectangle represents artists, the circle represents players and the triangle represents doctors.



How many players are neither artists nor doctors? How many players are neither artists nor doctors?

- (1) 3
- (2) 8
- (3) 22
- (4) 25

20) Direction (89 to 90):- Study the following figure carefully and answer the questions given below it. The rectangle represents artists, the circle represents palyers and the triangle represents doctors.



How many artists are players?

- (1) 30
- (2) 29
- (3) 25
- (4) 22

ANSWER KEYS

PART-I : PHYSICS

Q.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A.	3	3	3	1	2	2	1	2	1	1	3	2	1	3	3	4	1	4	4	1
Q.	21	22	23	24	25	26	27	28	29	30										
A.	3	3	3	3	1	3	3	1	3	1										

PART-II : CHEMISTRY

Q.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A.	4	2	4	2	4	3	2	4	1	2	3	4	4	2	1	2	3	4	1	2
Q.	51	52	53	54	55	56	57	58	59	60										
A.	3	1	2	1	3	4	2	3	4	4										

PART-III : MATHEMATICS

Q.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
A.	2	3	2	4	3	4	3	1	2	3	3	3	3	4	1	1	1	1	3	2
Q.	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A.	1	1	2	2	3	1	1	4	2	3	1	3	2	3	4	2	2	3	2	1

PART-IV(A) : English Proficiency

Q.	101	102	103	104	105	106	107	108	109	110
A.	4	2	1	3	2	4	3	2	1	3

PART-IV(B) : Logical Reasoning

Q.	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130
A.	1	3	1	3	2	4	1	2	4	3	3	3	4	4	3	4	2	3	4	3

SOLUTIONS

PART-I : PHYSICS

$$1) \quad I_{\alpha} = \left(\frac{MR^2}{2} \right) \times \left(\frac{a}{R} \right)$$

$$a = \frac{d^2x}{dt^2} = -0.2 \times 100 \cos(10t)$$

$$= -20 \cos(10t)$$

$$a = \frac{a}{R} = -200 \cos(10t)$$

$$= -\frac{5 \times (0.1)^2}{2} \times 200 \cos(10t) = -\frac{5}{2} \times 2 \times \cos(10t)$$

$$= -5 \cos(10t)$$

$$\tau_{\max} = 5 \text{ N} \times \text{m}$$

$$3) \quad T = \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{\ell}{g}}$$

$$\Rightarrow \frac{2\pi}{2} = 2\pi \sqrt{\frac{\ell}{g}}$$

$$\frac{1}{4} = \frac{\ell}{g}$$

$$\ell = \frac{g}{4} = 2.5 \text{ m}$$

$$4) \quad \gamma_{\text{app.}} = \frac{\Delta V}{V \Delta T} = \frac{V/100}{V(80)} = \frac{1}{8000}$$

$$= 1.25 \times 10^{-4} / ^\circ\text{C}$$

5) Relation between measurement of different scales

$$\frac{x - L_1}{U_1 - L_1} = \frac{y - L_2}{U_2 - L_2}$$

x and y are measurement in two scales

L_1, L_2 is ice point measurement, U_1, U_2 is steam point measurement in two scales

Applying in the given case

$$\frac{5 - (-20)}{200} = \frac{y - 0}{100} \Rightarrow y = 12.5$$

7) Since $a = 1$, sun can be assumed to be emitting as a black body from Wien's law for a black body

$$\lambda_m \cdot T = b \Rightarrow T = \frac{b}{\lambda_m}$$

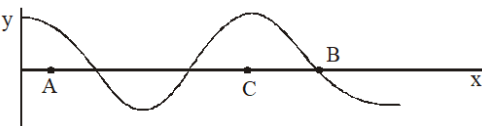
$$= \frac{0.282 \text{ (cm-K)}}{(470 \times 10^{-7} \text{ cm})} \simeq 6125 \text{ K}$$

$$\begin{aligned} 8) Q &= W = nRT \ln \frac{V_f}{V_i}; \\ T &= \frac{Q}{nR \ln V_f/V_i} = \frac{1500}{0.5 \times 25/3 \times \ln 3} \\ &= \frac{1500}{0.5 \times 25/3 \times 1} = 360 \text{ K} \end{aligned}$$

$$\begin{aligned} 9) & \text{At constant pressure} \\ \Delta Q &= nC_p \Delta T = \frac{5}{2} nR \Delta T \\ W &= nT \Delta T \\ \text{So } W &= \frac{2}{5} \Delta Q \end{aligned}$$

$$10) \Delta P = -B \frac{\partial y}{\partial x}$$

so, y - x graph is



Now shift graph in +x direction and find direction of velocity of particles.

$$11) y = \frac{a}{2} [\cos(2\omega t - 2kx) + 1]$$

$$12) \text{Energy in 1}^{\text{st}} \text{ orbit} = y \text{ J; P.E.} = 2y \text{ J; P.E. in 2}^{\text{nd}} \text{ orbit} = \frac{2y}{4} = \frac{y}{2} \text{ J}$$

$$\begin{aligned} 13) mvr &= \frac{nh}{2\pi}; \lambda_{\text{de-Broglie}} = \frac{h}{mv} \\ \therefore \text{For first orbit, } n &= 1, \frac{h}{mv} = 2\pi r \end{aligned}$$

$$\begin{aligned} 15) & \text{At equator } g_{\text{eff}} = g - \omega^2 R \\ & \text{Time period of pendulum} \\ T &= 2\pi \sqrt{\frac{\ell}{g_{\text{eff}}}} = \infty \Rightarrow g_{\text{eff}} = 0 \\ \Rightarrow \omega &= \sqrt{\frac{g}{R}} \\ & \text{Length of the day} \end{aligned}$$

$$= \frac{2\pi}{\omega} = 2\pi \sqrt{\frac{R}{g}} = 2\pi \sqrt{\frac{6400 \times 10^3}{10}} \text{ sec} \approx 1.4 \text{ hr}$$

$$17) \Sigma F = ma_{\text{cm}} ; mg \cos \theta - N - ma_{\text{cm}}$$

$$\Sigma F = I\alpha ; mg \cos \theta \times \frac{\ell}{2} = \frac{m\ell^2}{3}\alpha$$

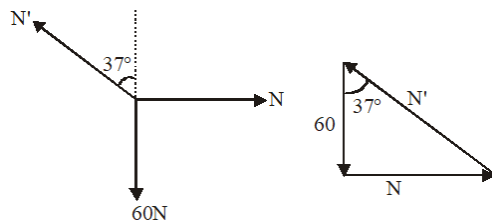
$$\text{Also, } mg \sin \theta = \frac{m\omega^2 \ell}{2}$$

$$mg \frac{\ell}{2} \sin \theta = \frac{1}{2} \frac{m\ell^2}{3} \omega^2$$

$$\text{and } a_{\text{cm}} = \frac{\ell}{2} \alpha$$

$$f = \mu N$$

$$\text{Solving } \theta = \tan^{-1} \left(\frac{\mu}{10} \right)$$



18)

F.B.D. of system "sphere + block"

$$\frac{N}{60} = \frac{3}{4}$$

$$N = 45 \text{ Newton}$$

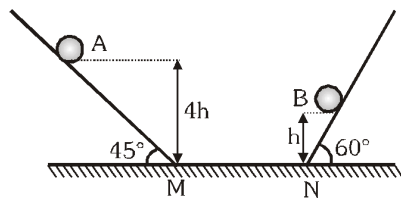
$$19) \omega = \frac{1}{\sqrt{LC}}, E_0 = \frac{10^{-9}}{10^{-11}} = 100V$$

$$I = \frac{E_0}{R} = 1A$$

$$\frac{q}{C} = IX_C = \frac{I}{\omega C}$$

$$q = 10^{-8} \text{ C}$$

20) The figure



$$H_A = h, H_B = 4h$$

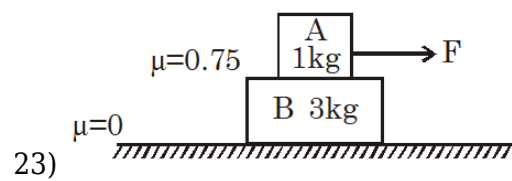
21) After collision of C and A, the velocity of A becomes v_0 (elastic head on collision).

For spring blocks-system, at max. compression the velocity of system will be v_{cm} .

$$\text{From energy conservation : } \frac{1}{2} m \times v_0^2$$

$$= \frac{1}{2} 3m \times \frac{v_0^2}{9} + \frac{1}{2} kx_0^2$$

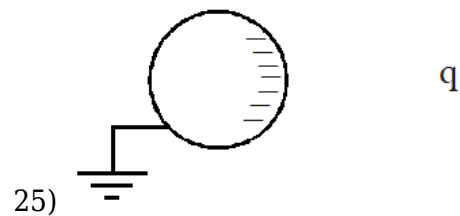
$$\text{and } v_{cm} = \frac{mv_0}{3m} = \frac{v_0}{3} \text{ m/s}$$



$$F_{\max} = \frac{m_1}{m_2} \mu g (m_1 + m_2)$$

$$= \frac{1}{3} \times \frac{3}{4} \times g \times 4$$

$$= gN = 9.8 \text{ N}$$



26)

$$dU = \left(\frac{1}{2} \epsilon_0 E^2 \right) dV$$

$$= \left(\frac{1}{2} \epsilon_0 (3y)^2 \right) (a^2 dy)$$

$$U = \int_{y=0}^{y=a} dU = \frac{3}{2} \epsilon_0 a^5$$

27)

$$PA = F = kx \Rightarrow \frac{\sigma^2}{2\epsilon_0} \pi R^2 = kx \Rightarrow x = \frac{\sigma^2 \pi R^2}{2\epsilon_0 k}$$

28)

$$v_r = v_{br} \sin \theta$$

$$3 = 5 \sin \theta$$

$$\sin \theta = \frac{3}{5}$$

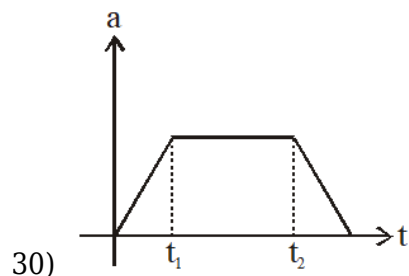
$$\theta = 37^\circ$$

$$\Rightarrow t = \frac{p}{v_{br} \tan \theta}$$

$$\frac{15}{60} = \frac{p \times 5}{5 \times 4}$$

$$p = 1 \text{ km}$$

29) $F_1 = F_2 = 50 \times 0.4 = 20 \text{ N}$ because total extension in spring will be 40 cm.



30)

ΔV = area under a v/s t graph.

$V-0$ = area under a v/s t graph

$$KE = \left(\frac{1}{2}mV^2\right) \propto V^2$$

&

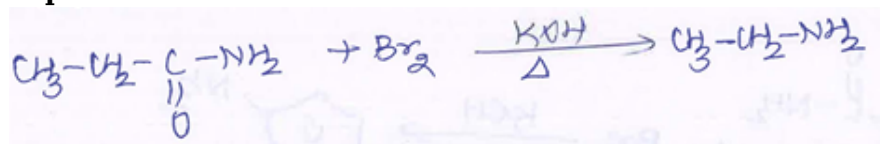
$$KE \propto (\text{area})^2$$

PART-II : CHEMISTRY

40) **Asking about :-** Product 'P' of reaction.

Concepts :- Hoffmann Bromamide Degradation Reaction.

Explanation :-



$$K_{sp} = s^2$$

$$s = \sqrt{K_{sp}}$$

58)

The stoichiometry of change has no bearing on the energy of activation. It represents a certain value for a given change.

$$E_a = E^\ddagger$$

PART-III : MATHEMATICS

62) Any tangent to $y = x^2$ can be written as

$$y = mx - \frac{1}{4}m^2 \text{ if it touches } 2^{\text{nd}}, \text{ then}$$

$$mx - \frac{m^2}{4} = x^2 - 2x + 2$$

$$\Rightarrow x^2 - (2+m)x + \left(2 + \frac{m^2}{4}\right) = 0$$

$$D = 0 \Rightarrow (m+2)^2 - 4 \left(2 + \frac{m^2}{4} \right)$$

$$4m - 4 = 0 \Rightarrow m = 1 \Rightarrow 4x - 4y - 1 = 0$$

63) Let $z = a + ib$ then,

$$\frac{1}{\bar{z}} = \frac{1}{a + ib} = \frac{\bar{z}}{z\bar{z}} = \frac{\bar{z}}{|z|^2} = \left(\frac{a - ib}{a^2 + b^2} \right) \dots (1)$$

Since $z + \bar{z} = 2a = 2\text{Re}(z)$

$$\bar{z} = 2\text{Re}(z) - z$$

$$\frac{1}{\bar{z}} = \frac{2\text{Re}(z) - z}{|z|^2} \text{ using (1)}$$

$$2\text{Re}(z) - z = \frac{|z|^2}{\bar{z}} \dots (2)$$

Thus the given expression is

$$\frac{z \left[|z|^2 - 1 \right] + 2\text{Re}(z)}{\frac{|z|^2}{\bar{z}}}$$

$$= z + \frac{2\text{Re}(z) - z}{|z|^2} = z + \frac{1}{\bar{z}} \text{ using (2)}$$

65) The curve cuts x-axis at (1, 0)

$$y' = \left(\sqrt{5-x^6} \right) \cdot 3x^2 - \left(\sqrt{5-x^4} \right) 2x$$

$$y'|_{x=1} = \left(\sqrt{5-1} \right) 3 - \left(\sqrt{5-1} \right) 2$$

$$\tan \theta = 6 - 4$$

$$\theta = \tan^{-1} 2 = \cot^{-1} \frac{1}{2}$$

66) For parallel lines $\frac{\lambda-3}{\mu-3} = \frac{\mu+3}{\lambda+3}$

$$\Rightarrow \lambda^2 = \mu^2$$

and for $\lambda = \mu$ lines become coincident

for perpendicular lines $\left(-\frac{\lambda-3}{\mu+3} \right) \cdot \left(-\frac{\mu-3}{\lambda+3} \right) = -1$

$$\Rightarrow \lambda\mu = -9$$

68) We have $y - e^{xy} + x = 0$

Differentiating each side w.r.t. x we get

$$\Rightarrow \frac{dy}{dx} - e^{xy} \left(x \frac{dy}{dx} + y \cdot 1 \right) + 1 = 0$$

$$\Rightarrow \frac{dy}{dx} (1 - x e^{xy}) = -1 + y e^{xy}$$

$$\Rightarrow \frac{dy}{dx} = \frac{-1 + y e^{xy}}{1 - x e^{xy}}$$

$$\Rightarrow \left(\frac{dy}{dx} \right)_{(1,0)} = \frac{-1+0}{1-1} = \infty$$

Hence vertical tangent at point (1, 0)

$$\phi(x) = \int_0^{x^2} f(x) dx$$

69) Let

$$\text{then } \phi'(x) = 2xf(x^2)$$

$$\phi(0) = 0 \text{ \& } \phi(2) = \int_0^4 f(x) dx$$

using LMVT, we have some $c \in (0, 2)$ such that

$$\phi'(c) = \frac{\phi(2) - \phi(0)}{2 - 0} \Rightarrow 2cf(c^2) = \frac{\int_0^4 f(x) dx}{2}$$

$$\int_0^4 f(x) dx = 4cf(c^2)$$

or 0

71) Put $x = 0$ on both sides and evaluate determinant.

74) Let point (h, k)

$$\sqrt{(h-a\lambda)^2 + k^2} = \lambda \sqrt{\left(h - \frac{a}{\lambda}\right)^2 + k^2}$$

$$= \left(h^2 + \frac{a^2}{\lambda^2} - \frac{2ah}{\lambda}\right) \lambda^2 + \lambda k^2$$

$$h^2 + a^2\lambda^2 - 2ah + k^2$$

$$\Rightarrow h^2(\lambda^2 - 1) + k^2(\lambda^2 - 1) = a^2(\lambda^2 - 1)$$

$$(\lambda^2 - 1)(h^2 + k^2 - a^2) = 0, \lambda \neq \pm 1$$

$$h^2 + k^2 = a^2$$

$$x^2 + y^2 = a^2$$

75) Let $yt = x + 2t^2$ be the tangent passing through (-2, 3)

$$\therefore 3t = -2 + 2t^2 \Rightarrow 2t^2 - 3t - 2 = 0$$

$$t_1 + t_2 = \frac{3}{2}$$

$$\therefore 4t_1 + 4t_2 = 6$$

$$76) L = \lim_{x \rightarrow -\infty} \frac{x^5 \sin\left(\frac{1}{\pi x^2}\right) + 3|x|^2 + 70}{|x|^3 + 7|x| + 18}$$

$$= \lim_{x \rightarrow -\infty} \frac{x^5 \sin\left(\frac{1}{\pi x^2}\right) + 3x^2 + 70}{-x^3 - 7x + 18} \quad (\because x < 0)$$

$$\begin{aligned}
&= \lim_{x \rightarrow -\infty} \frac{x^2 \sin\left(\frac{1}{\pi x^2}\right) + \frac{3}{x} + \frac{70}{x^3}}{-1 - \frac{7}{x^2} + \frac{18}{x^3}} \\
&= \lim_{x \rightarrow -\infty} \frac{\frac{\sin\left(\frac{1}{\pi x^2}\right)}{\frac{1}{\pi x^2}} + \frac{3}{x} + \frac{70}{x^3}}{-1 - \frac{7}{x^2} + \frac{18}{x^3}} = -\frac{1}{\pi}
\end{aligned}$$

$$\begin{aligned}
77) y &= (A + Bx) e^{mx} + (m-1)^{-2} e^x \\
\frac{dy}{dx} &= m e^{mx} (A + Bx) + B e^{mx} + \frac{e^x}{(m-1)^2} \\
\frac{d^2y}{dx^2} &= m^2 e^{mx} (A + Bx) + B m e^{mx} + B m e^{mx} + \frac{e^x}{(m-1)^2} \\
\frac{d^2y}{dx^2} &= 2m \frac{dy}{dx} + m^2 y \\
\frac{d^2y}{dx^2} &= 2m^2 e^{mx} (A + Bx) - 2m B e^{mx} \\
&\quad - \frac{2m}{(m-1)^2} e^x + m^2 e^{mx} (A + Bx) + \frac{m^2 e^x}{(m-1)^2} \\
&= \frac{(1 + m^2 - 2m)}{(m-1)^2} e^x = e^x
\end{aligned}$$

$$\begin{aligned}
78) y &= 2^{x(x-2)} \\
x &= 2^{y(y-2)} \\
\Rightarrow y^2 - 2y &= \log_2 x \\
\Rightarrow (y-1)^2 &= 1 + \log_2 x \\
\Rightarrow y-1 &= \pm \sqrt{1 + \log_2 x} \\
\Rightarrow y &= 1 \pm \sqrt{1 + \log_2 x} \\
\therefore f^{-1} : \left[\frac{1}{2}, \infty\right) &\rightarrow (-\infty, +1] \\
\Rightarrow y &= 1 - \sqrt{1 + \log_2 x}
\end{aligned}$$

79) Put $y = -x$, we get $f(x) = -x$ also $f(0) = 0$
 $f(x+y) = f(x) + f(y)$ is an odd function so it is symmetric about origin.

$$\begin{aligned}
81) \text{ Let } P \text{ is } (h, k) \text{ then equation of chord of contact is } \frac{hx}{16} - ky &= 1 \text{ as it parallel to tangent} \\
\frac{5x}{16} - \frac{3}{4}y &= 1 \\
\therefore \frac{h/16}{k} &= \frac{5/16}{3/4} \Rightarrow 3x = 20y \\
&\text{which is a straight line.}
\end{aligned}$$

$$82) \int_a^x y(t) dt = x^2 + y(x)$$

$$\begin{aligned}
&\Rightarrow xy = 2x + \frac{dy}{dx} \\
&\Rightarrow x(y-2) = \frac{dy}{dx} \\
&\Rightarrow \int x dx = \int \frac{dy}{y-2} \\
&\Rightarrow \frac{x^2}{2} = \ln|y-2| + \ln c \\
&\Rightarrow e^{\frac{x^2}{2}} = c(y-2) \\
&\text{at } x = a, y = -a^2 \\
&\therefore e^{\frac{a^2}{2}} = c(-a^2-2) \Rightarrow c = -\frac{e^{\frac{a^2}{2}}}{(a^2+2)} \\
&\therefore e^{\frac{a^2}{2}} = \frac{e^{\frac{a^2}{2}}}{(a^2+2)}(y-2) \\
&\Rightarrow -y+2 = (a^2+2)e^{\frac{x^2-a^2}{2}} \\
&\Rightarrow y = 2 - (2+a^2)e^{\frac{x^2-a^2}{2}}
\end{aligned}$$

83) We have $|PS_1 - PS_2| = 2a$

$$\Rightarrow \sqrt{h^2 + k^2 - 1} = 2.$$

$\therefore$ Required locus of other focus is $x^2 + y^2 = 9$.

$$84) \begin{vmatrix} a-\alpha & b & c \\ c & a-\alpha & b \\ b & c & a-\alpha \end{vmatrix} = 0$$

which is cubic equation in ' α ' in which coefficient of α^3 is -1 and constant term is

$$\begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$$

$\Rightarrow$ product of all the values of α

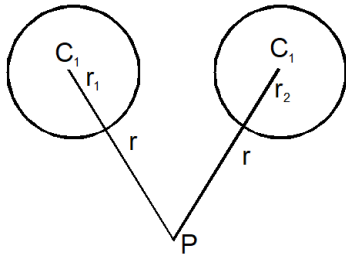
$\Rightarrow$ product of roots of cubic equation

$$\begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$$

$$= a^3 + b^3 + c^3 - 3abc$$

$$(a+b+c)(a^2+b^2+c^2-ab-bc-ac) > 0$$

85) Let C_1 & C_2 be the centre, r_1 & r_2 be the radii of the 2 circles



$$PC_1 = r + r_1 \quad PC_2 = r + r_2$$

$$PC_1 - PC_2 = r_1 - r_2$$

Hence (C)

86) Function is odd & its integral is zero.

$$A = \begin{bmatrix} a & 0 & 0 & 0 \\ 0 & b & 0 & 0 \\ 0 & 0 & c & 0 \\ 0 & 0 & 0 & d \end{bmatrix}$$

$$87) |A| = abcd$$

$$t_r(A) = a + b + c + d$$

$$AM \geq GM$$

$$\frac{a+b+c+d}{4} \geq (abcd)^{1/4}$$

$$(abcd)^{1/4} \leq 2$$

$$abcd \leq 16$$

$$|A| \leq 16$$

$$\begin{aligned} 88) \int_{-2}^4 f(x) dx &= \int_{-2}^{-1} f(x) dx + \int_{-1}^0 f(x) dx + \int_0^1 f(x) dx \\ &+ \int_1^2 f(x) dx + \int_2^3 f(x) dx + \int_3^4 f(x) dx \\ &= 2^2 + 1^2 + 0 + 1^2 + 2^2 + 3^2 = 19 \end{aligned}$$

$$A = \begin{bmatrix} 0 & 3 & 4 \\ 3 & 0 & 5 \\ 4 & 5 & 0 \end{bmatrix}$$

$$89)$$

$$\text{clearly } A^T = A$$

Hence A is symmetric while $|A| \neq 0$ hence it is not singular.

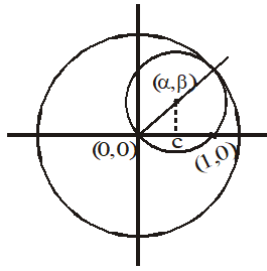
$$90) (A(A+B)^{-1}B)^{-1} = B^{-1}(A+B)A^{-1}$$

$$= (B^{-1}A + I)A^{-1}$$

$$= B^{-1} + A^{-1}$$

$$\Rightarrow A(A(A+B)^{-1}B)^{-1}B = A(B^{-1} + A^{-1})B$$

$$= (AB^{-1} + I)B = A + B$$



91)

$$C = (\alpha, 0) \equiv \left(\frac{1}{2}, 0\right)$$

$$2\sqrt{\frac{1}{4} + \beta^2} = 3$$

$$\frac{1}{4} + \beta^2 = \frac{9}{4}$$

$$\beta = \sqrt{2}$$

$$C \equiv \left(\frac{1}{2}, \sqrt{2}\right)$$

$$92) ax^2 + bx + c = 0, \quad bx^2 + cx + a = 0$$

Let common root be

$$a\alpha^2 + b\alpha + c = 0$$

$$b\alpha^2 + c\alpha + a = 0$$

$$\frac{\alpha^2}{ab - c^2} = \frac{\alpha}{bc - a^2} = \frac{1}{ac - b^2}$$

$$\alpha = \frac{bc - a^2}{ac - b^2}$$

$$(ab - c^2)(ac - b^2) = (bc - a^2)^2$$

$$a^2bc - ab^3 - ac^3 + b^2c^2 = b^2c^2 - 2a^2bc + a^4$$

$$a^3 + b^3 + c^3 - 3abc = 0$$

$$\frac{a^3 + b^3 + c^3}{abc} = 3$$

$$\therefore \left(\frac{a^3 + b^3 + c^3}{abc}\right)^2 = 9$$

$$93) P(\text{all tails or all heads in one trial}) = \frac{1}{4}$$

$$\therefore P(\text{this happens second time in 3rd trial}) = {}^2C_1 \times \frac{1}{4} \times \frac{3}{4} \times \frac{1}{4} = \frac{3}{32}$$

$$95) {}^5C_5 \cdot {}^nC_r + {}^5C_4 \cdot {}^nC_{r+1} + {}^5C_3 \cdot {}^nC_{r+2} + {}^5C_2 \cdot {}^nC_{r+3} + {}^5C_1 \cdot {}^nC_{r+4} + {}^5C_0 \cdot {}^nC_{r+5}$$

$$= \text{coff. of } x^{r+5} \text{ in } (1+x)^{n+5} = {}^{n+5}C_{r+5}$$

hence $k = 5$

$$96) \left. \begin{array}{l} \alpha + \beta = -6 \\ 3\alpha + 2\beta = -20 \\ \lambda = \alpha\beta = -16 \end{array} \right\} \text{ solving } \alpha = -8, \beta = 2$$

97) We have $\sin(\pi \cos \theta) = \cos(\pi \sin \theta)$

$$\Rightarrow \sin(\pi \cos \theta) = \sin\left(\frac{\pi}{2} \pm \pi \sin \theta\right)$$

$$\Rightarrow \pi \cos \theta = \frac{\pi}{2} \pm \pi \sin \theta \Rightarrow \cos \theta \mp \sin \theta = \frac{1}{2}$$

$$\Rightarrow \frac{1}{\sqrt{2}} \cos \theta \mp \frac{1}{\sqrt{2}} \sin \theta = \frac{1}{2\sqrt{2}}$$

$$\Rightarrow \cos\left(\theta \pm \frac{\pi}{4}\right) = \frac{1}{2\sqrt{2}} \Rightarrow \cos\left(\theta \pm \frac{\pi}{4}\right) = \frac{1}{2} \cos \frac{\pi}{4}$$

98) We know that

$$(1 + \tan k^\circ)(1 + \tan(45 - k)^\circ) = 2$$

$$\Rightarrow (1 + \tan 1^\circ)(1 + \tan 2^\circ) \dots \dots$$

$$(1 + \tan 44^\circ)(1 + \tan 45^\circ)$$

$$= 2\{(1 + \tan 1^\circ)(1 + \tan 44^\circ)\} \cdot \{(1 + \tan 2^\circ)$$

$$(1 + \tan 43^\circ)\} \dots \dots \{(1 + \tan 22^\circ)(1 + \tan 23^\circ)\} =$$

$$2 \cdot 2^{22} = 2^{23}$$

$$\therefore n = 23$$

99) Let the first 3 terms be $\frac{a}{r}$, a , ar

$$\frac{\frac{a}{r}}{a\left(r + \frac{1}{r} + 1\right)} = \frac{1}{1 + r + \frac{1}{r}} \leq \frac{1}{3}$$

Hence

$$\left(\text{as } r + \frac{1}{r} \geq 2\right)$$

100) Let mid point of chord joining given points is $M\left(\frac{5}{2}, -2\right)$.

If tangents at any two points intersect at T & mid point of given two points be M, then axis of the parabola will be parallel to TM.

Hence slope of axis of parabola

$$= \text{slope of TM} = 0$$

PART-IV(A) : English Proficiency

101) **Explanation:** Verbs like bid, make, let, and help are not followed by 'to' in active voice. But when changed into passive voice, they take 'to' after them.

102) **Explanation:** When words like 'pleased, disgusted, annoyed, satisfied, cramped, decorated, ornamented, filled, and impressed' are used in active voice, we use 'with' in place of 'by'.

103) **Explanation:** The one word for the belief that nothing has meaning or value is Nihilism that means Emptiness/negativism/pessimism.

104) The one word for small objects kept for decoration is Bric-o-brac.

105) According to the given passage the correct answer to the question will be option B only.

106) According to the given passage the correct answer to the question will be option D only.

107) According to the given passage the correct answer to the question will be option C only.

108) Arrangement in option B gives meaning to the passage.

109) Arrangement in option A gives meaning to the passage.

110) In the sentence though it is "react", not "reacts" (again, that's because we have the verb "require that", which removes the -s from the end of a verb referring to the third person). Therefore, the other two verbs must both be in this form, giving us "strategize" and "persevere".

PART-IV(B) : Logical Reasoning

111) A sector is the region of a circle that is enclosed between two radii. Therefore Option A is correct.

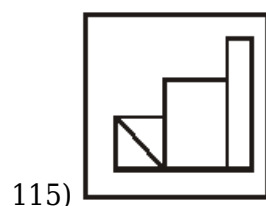
$$112) (12 + 28 + 7 + 17) \div 4 = 16$$

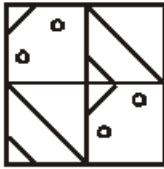
$$(2+14+8+12) \div 4 = 9$$

$$\text{Similarly, } (21 + 15 + 33 + 23) \div 4 = 23$$

Therefore, Option C is correct.

113) Given passage does not express the ideas given in assumptions II and III. Therefore Option A is correct.





116)

118) **Explanation:** A direct train is available from Kota to Jaipur. Similarly, a direct train is available from Mumbai to Kota. Therefore, Option B is correct.

119) **Explanation:**

A $\xrightarrow{+3 \text{ Positions}}$ E, (Numeric value of A) + (Numeric value of E) = 6

S $\xrightarrow{+3 \text{ Positions}}$ W, (Numeric value of S) + (Numeric value of W) = 42

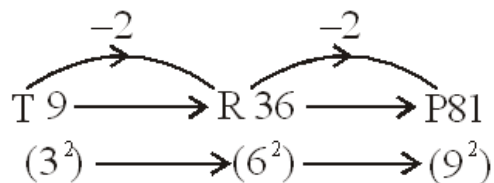
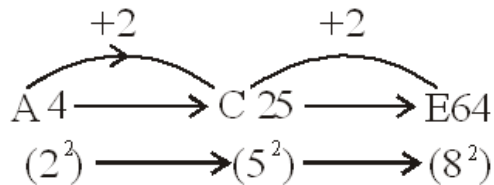
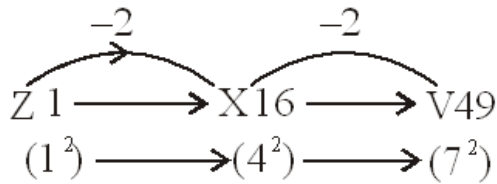
H $\xrightarrow{+3 \text{ Positions}}$ L, (Numeric value of H) + (Numeric value of L) = 20

O $\xrightarrow{+3 \text{ Positions}}$ S, (Numeric value of O) + (Numeric value of S) = 34

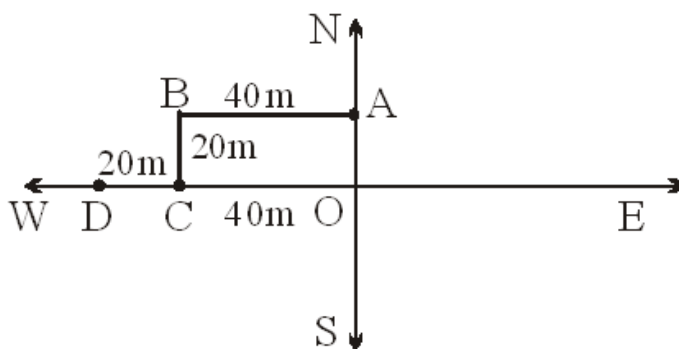
Therefore option D is correct

V $\xrightarrow{+3 \text{ Positions}}$ Z, (Numeric value of V) + (Numeric value of Z) = 48

120) **Explanation:** Except Watermelon, all others are citrus fruits, therefore Option C is correct.



121)



126)

Let mahesh starts from point O. His final position is D
∴ He is 60m from his original position.

127) ∵ M is not present is INTERNATIONAL
∵ TERMINAL can't be made from
INTERNATIONAL

128) After replacing the sign $(3 \times 15 + 19) \div 8 - 6$ applying BODMAS rule
 $= (45 + 19) \div 8 - 6$
 $= 64 \div 8 - 6 = 8 - 6 = 2$

129) Number of persons is circle region but not included in triangle and rectangle = 25

130) Number of persons common to rectangle and circle = $22 + 3 = 25$